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Fullarton's Atlas of England and Wales, on a scale of 4 miles to an inch; presented by the Author. Three sheets of Stieler's Hand Atlas; presented by Dr. A. Petermann. Admiralty Charts, 32 sheets, presented through the Hydrographer, Capt. G. H. Richards.

The following Papers were read:—

1. *On the Physical Geography of the Lower Indus.* By Colonel C. W. TREMENHEERE, R.E.

(Abstract.)

THE province of Sind extends from Mittee, on the north, where it joins the Punjab, to the sea near the mouths of the Indus; and consists of a continuous plain, varying in width, through which the river Indus passes. The physical aspect of this immense plain presents a very remarkable uniformity throughout—

- 1st. In the entire absence of channels for natural drainage.
- 2nd. In its almost uniform slope, both towards the sea, and away from the river-banks.

- 3rd. In its mineral character.

The slope of the valley, in a direct line to the sea, 330 miles, is 7·8 feet, or 9·3 inches per mile, and the lateral slopes on either side of the river are in many cases quite as much. The river, in fact, passes along a ridge, and is many feet above the land a few miles distant on either side of it.

The actual course of the river, measured on the map, is about 540 miles, and the surface slope during the inundation amounts to 478 of a foot, or about 5·7 inches per mile. The soil consists entirely of a very fine siliceous deposit, mixed with a variable proportion of argillaceous matter, with much mica. Such is the uniform fineness of the soil, that it is impossible to find a grain of sand in the plain as large as a pin's head.

The Indus, like other tropical rivers, is subject to annual inundation, the extent of which has been carefully registered for many years, both at Sukkur and Kotree. At the former place the rise from the low-season level amounts to from 13 to 15 feet, while at Kotree, though lower down the river, the rise is generally about 2 feet more.

The amount of silt contained in the river-water is remarkably great. From a series of careful observations made at Sukkur and Kotree, it has been ascertained that, at the height of inundation, the solid matter in the water amounted to about 43·6 parts in 10,000 by weight, and at the end of December to 17 parts. The discharge of the river at the former period is about 380,000 cubic feet per second, and at the latter about 68,000. Assuming a mean discharge

of 200,000 cubic feet, and that the solid matter amounts to 25 parts in 10,000, there would be $217\frac{1}{4}$ millions of cubic yards of solid matter carried to the sea in a year, sufficient to cover 70 square miles with a deposit a yard in thickness.

If the Indus, like an ordinary drainage-channel, had taken its course through the lowest ground in the valley, it would have passed down the still existing channel, called the Rhein, into the Eastern Narra, and by Nowacote to the Run of Cutch. These old channels are still of very considerable size, and it is an interesting question whether they indicate the course of the river, or of any of its branches at any former period.

The country between the Narra and the present course of the river contains many remains of old channels, some of which extend for many miles continuously, and have well-defined banks with a glacis on each side. They have, in many cases, very tortuous courses; but are straighter as they approach the sea. There are many of these old channels to the eastward of the present course of the river, while such marks are rare and indistinct to the westward; so that one is led to the conclusion that the river has gradually worked to the westward. There is, unfortunately, no very authentic map of the Eastern Delta or of the country south of Hyderabad, showing the course of the old channels referred to, which terminate in the Run of Cutch. It is possible that formerly the chief outlets of the river may have been by these channels; and that the accumulation of enormous deposit derived from the river in the Run, in conjunction with an upheaval of the land on the border of the Run, which there are grounds to believe took place in 1819, may have forced the river to form new channels to the ocean. The completion of the survey of the Eastern Delta, and the extension of the series of levels over a portion of the Run of Cutch, will probably throw light upon the point.

During the inundation, when the river is carrying a very large body of water, its course is much more direct than in its low state; when the water not only follows the course of the larger reaches, but winds from side to side, and round the extensive sand-banks left in the bed. The surface-slope is thus, by an automatic action, continually adapting itself to the varying amount of discharge: and I think it may be generally stated of rivers flowing through such plains that the larger the body of water, and the less the surface-slope of the plain, the more direct will be the course of the river; and, on the contrary, the sharpness of the bends of a large river, flowing through such a plain, will indicate the existence of a considerable slope. I infer, in this manner, that the valley of the Tigris,

above the marshes, must have a greater slope than that of the Indus. The general statement I venture to make is that, with a fixed or virtually fixed maximum discharge, and an ascertained difference of level between any two points on a large river passing through an alluvial plain, the length of the river's course is also absolutely fixed. The longer, therefore, a river becomes by extending its delta to seaward, the greater tendency will there be to assume a more direct course.

The Delta commences about 7 miles south of the old town of Tatta on the right bank. The Buggaur and the Suttah (called the Hujamree near the sea) leave the river from the right bank, and the Mootnee and the Mull from its left. There are thus only five channels by which the river discharges into the sea.

The Western Delta has been recently surveyed by Captain Macdonald, and my map has been reduced from his survey, and accurately represents the district. The coast will be seen to extend in nearly a straight line from the mouth of the Hujamree to the entrance to Kurrachee Harbour, and is formed by a line of sand-bank topped by low dunes. The coast to seaward is extremely flat, and the extent of shore left dry at low water is very considerable. Behind the screen formed by the coast-line there is a very large area of marsh-land, permeated in every direction by tortuous creeks and channels, the tidal water to supply which is derived from a number of wide but shallow openings on the coast-line. These openings have been most improperly called mouths of the Indus; but it is obvious that they are, in fact, merely passages for the tidal water to and from the lagoon. Within the lagoon the channels are well defined, though very tortuous, and deepen gradually as the distance from the Indus increases. The soundings in those to the northward are as much as 3, 4, and $4\frac{1}{2}$ fathoms at low water, at the distance of many miles from the sea. The mud-banks within this lagoon have now been raised nearly to the level of ordinary high-water mark, by deposits of mud on which mangrove and soda plants are the only vegetation. This mud is blue-black in colour, and very fine; but when dried it becomes of the same light-drab colour as the Indus mud.

The bay and harbour of Kurrachee are situated at the extreme northern end of this delta. The bay is formed by Manora Point, a natural hill consisting of clay-beds capped by conglomerate, at the southern extremity of a reef about 10 miles in length, by which it is united to the mainland, and on which the action of the surf, which breaks directly upon it, has formed a beach capped by a narrow ridge of blown sand.

The opening of the bay between Manora and Clifton is about $3\frac{1}{2}$ miles wide, but this opening is blocked by rocky islands in the centre, and by the island of Keamaree at some distance in the rear.

The entrance to the harbour, and the only navigable channel, is close to Manora: the anchorage extending from within the shelter of that point to opposite the western end of Keamaree. With the exception of this comparatively deep portion, and of two branches of no great extent, the whole space within presents, at low water, an area of extensive mud-flats, some of which are covered by mangrove-bushes. The tidal area is generally at a level of 6 or 8 feet above low water, or from 1 to 3 feet below high water at spring-tides.

The surface consists of a layer, from 3 to 6 feet thick, of stiff black mud formed of silt mixed with decayed vegetable matter, lying on a bed of sand of variable quality—in some places fine and very thick, in others coarser—containing sea-shells, or approaching gravel. The whole overlies a bed of stiff blue clay, which appears to be the natural surface. The superficial deposits extend from 9 to 25 feet below low-water mark. On examining the superficial deposits it has been found that the black mud, mixed with vegetable matter, is identical with that formed on the mud-banks within the lagoon which has been described. Its mineral character, as well as that of the fine sands below it, and the whole surface of Keamaree, is marked by the presence of a very fine white quartz mixed with mica, and is identical with the silt carried to sea in the waters of the Indus.

The agency by which the Indus silt is swept so far to the northward will be understood by referring to the map of the coast-line.

The South-west Monsoon breaks upon this coast early in May, and lasts without cessation until the middle of September: during the whole of which period a heavy surf beats upon the shore. It is precisely during this period that the Indus is discharging its flood-waters, so heavily charged with sand and silt. The direction in which the surf breaks is marked upon the map by a series of parallel blue dotted lines, which form a considerable angle with the general coast-line. The result of this oblique action of the sea-stroke, upon a coast exposed to winds which prevail continuously for so long a period, is not only to force matter held in suspension in the water, in the direction of the stroke, but, as explained by Sir Henry de la Beche, to produce a shore current. The manner in which the deposit in the lagoon, and within Kurrachee Harbour, has been formed, is extremely well described in the 'Geological Observer,' and it would appear that the whole shore-line, between the mouths

of the Indus and Manora, has been formed by the action of the sea-stroke forcing the sand and silt, discharged by the river, in the direction of Kurrachee Harbour.

The rise of the tides on this coast varies from 8 to 11 feet at springs. Their course is in a direction parallel to the coast-line: the flood-tide coming from the north-west, and the ebb running in the opposite direction. During the monsoon months there is a current in the offing, setting to the south-east, in a direction contrary to that along the coast, which has been described. Both currents are produced by the same cause, the action of the long-continued sea-stroke on a coast-line forming a considerable angle with the crests of the monsoon waves.

By the action of the current in the offing it is probable that much silt, which has been swept to the northward as far as Kurrachee Harbour, may be again carried to the southward, and be eventually deposited in the Eastern Delta channels, or carried into the Run of Cutch.

The action which I have endeavoured to trace must have a considerable influence in checking the growth of the Delta of the Indus to seaward: the surf of each successive Monsoon, exerting its immense power in removing any deposit which would otherwise tend to extend the channels by which the river discharges itself into the ocean. The progress of the delta to seaward is thus dependent upon the advance of the whole coast-line between the mouths of the river and Ghuzree, which must be extremely slow.

The paper will be published *in extenso*, with Map, in the Journal, vol. xxxvii.

Mr. W. P. ANDREW (Chairman of the Scinde, Punjab, and Delhi Railway Company) said that the importance attaching to the harbour of Kurrachee could only be comprehended when we kept in mind the vast extent of our Indian possessions, containing an area equal to the whole of Europe, without Russia, and a population of two hundred millions, and having almost every variety of climate and soil, producing in abundance the staples of our home manufactures, and the fact that there were only four seaports around the enormous circuit of the coast of Hindostan. Two of these were very bad, one being merely an open roadstead. Bombay was the best one, and, though Kurrachee had been decried in some degree by the author of the paper, he thought he should be able to prove that the gallant officer was wrong in his opinion, and that at Kurrachee also we possessed a valuable harbour. The route of the Indus had always been regarded by our statesmen, from the time of Sir Henry Pottinger to Sir Charles Napier and Sir Bartle Frere, as the most important political line in our Eastern possessions, and if an erroneous impression obtained of the deterioration of Kurrachee, the natural port of that route, it might deter its improvement for a considerable period. A few words stated to have been used at another meeting in this country lately, had produced a most depressing effect upon the inhabitants of Kurrachee, so much so that they had memorialised the Government; and he had no doubt that

Colonel Tremenheere would regret that such statements had been made. For instance, it was reported that a million of money had been spent upon Kurrachee Harbour.* That was really not the case. A quarter of a million was spent in various improvements; but of that sum only 57,000*l.* was spent upon the work of removing the bar. Another statement was said to have been made, to the effect that the port was a decaying port. So far from this being the case, during the last ten years the commerce of the port had risen from 1,400,000*l.* to upwards of 4,000,000*l.* last year; † the municipal dues from under 4000*l.* a year to 24,000*l.*; and the population from 40,000 to 60,000; and there were new streets and houses more resembling those of an English town than any other town in India. These facts he had taken from official returns compiled under the authority of Government. How could any port give more striking proof of growing prosperity. Sir Charles Nicholson, however, and Mr. Markham, the gentlemen who were reported as having used the expressions unfavourable to Kurrachee, had since assured him that they had been erroneously reported: and they entirely disavowed the statements attributed to them. With regard to the engineering part of the question, it was not for him to enter into details; but it might easily be shown that the views of the gallant officer were quite erroneous. His own experiment with the bottles offered a singular confutation of his theory, for not a single bottle was found to have got into Kurrachee out of the thousand bottles which he placed on the surface of the water at the mouth of the Indus. They made the voyage in the direction of Kurrachee, and they might possibly have gone into the mouth of the harbour, but, according to the gallant officer's own statement, met another current which carried them away somewhere else. The only other point

* This was in an erroneous report of a discussion at a meeting of Section E at the British Association, Nottingham.—[ED.]

†

ANNUAL TRADE OF KURRACHEE HARBOUR.

| Year. | Imports. | Exports. | Total. |
|---------|-----------|-----------|-----------|
| | £. | £. | £. |
| 1843-44 | 121,150 | 1,010 | 122,160 |
| 1844-45 | 217,700 | 9,300 | 227,000 |
| 1845-46 | 312,900 | 40,500 | 353,400 |
| 1846-47 | 293,400 | 49,300 | 342,700 |
| 1847-48 | 287,872 | 154,730 | 442,680 |
| 1848-49 | 344,715 | 107,133 | 451,849 |
| 1849-50 | 419,352 | 114,378 | 533,731 |
| 1850-51 | 425,831 | 196,461 | 622,293 |
| 1851-52 | 489,220 | 244,222 | 733,343 |
| 1852-53 | 535,690 | 376,337 | 800,000 |
| 1853-54 | 508,793 | 376,310 | 885,103 |
| 1854-55 | 575,196 | 346,893 | 922,089 |
| 1855-56 | 629,813 | 604,440 | 1,234,253 |
| 1856-57 | 685,665 | 734,522 | 1,420,187 |
| 1857-58 | 1,081,100 | 1,078,100 | 2,159,200 |
| 1858-59 | 1,540,606 | 1,044,273 | 2,584,879 |
| 1859-60 | 1,712,752 | 947,336 | 2,660,088 |
| 1860-61 | 1,658,305 | 1,025,345 | 2,683,650 |
| 1861-62 | 1,593,670 | 1,372,884 | 2,966,554 |
| 1862-63 | 2,242,818 | 3,287,594 | 5,530,412 |
| 1863-64 | 2,474,737 | 4,188,073 | 6,662,810 |
| 1864-65 | 2,316,700 | 2,928,015 | 5,244,715 |
| 1865-66 | 2,019,550 | 2,792,793 | 4,812,343 |

that struck him in the paper related to the mica found on the bar. The mica came down from the Indus, and was, no doubt, mixed with the sand on the shore; it would, as a matter of course, mix with other sand and silt which came in when the South-west Monsoon prevailed. Regarding the facilities of entrance to the port, he could speak with some authority, inasmuch as he had, from his official connection with the undertakings which had been named, been concerned in sending 300 ships from this country to Kurrachee; and they had not lost any ship entering or leaving the harbour except one, and that occurred through the fault of the pilot, who had most improperly left the vessel during the night.

The CHAIRMAN said he held in his hand a table of the exports and imports of Kurrachee, and they corroborated what Mr. Andrew had stated. Considering that Kurrachee had no products of its own, the increase of trade was wonderful. It would be a matter of deep regret if the harbour of Kurrachee was lost to us, for he believed it was the safest and best harbour in all Western India, Bombay excepted.

Mr. W. PARKES said that the question raised by Colonel Tremenheere, of a coast current which he supposed to be running from the mouth of the Indus northward, had always been considered to be connected with the prospects of Kurrachee Harbour, although Colonel Tremenheere in his paper had drawn no definite conclusion to that effect. But the only logical conclusion which could be drawn from Colonel Tremenheere's premisses was this, that the sediment brought by the coast current was gradually deteriorating the harbour, and that it cannot be very long before the harbour will be completely destroyed. Colonel Tremenheere attributed very great results to the influence of this coast current. A bed of sand over the whole area of the harbour from 9 to 25 feet in thickness, mud-banks 3 to 6 feet thick on the top of this; a sandy island (Keamaree) 2 miles long, a quarter of a mile wide, and 10 to 20 feet above the sea level, a spit of sand running southward for 2 miles from its western extremity, and the harbour channel forming the anchorage itself, were all the work of the coast current. These were vast results, and if the cause which produced them were still in action, we must look for correspondingly large effects still being produced, and those effects cannot but be fatal to the permanency of the harbour. In justification of the generally accepted conclusion that Colonel Tremenheere does connect his theory with the anticipated absorption of the harbour into the Delta of the Indus he would refer to the circumstances under which it was first promulgated. In the early part of 1864 he was on a visit to Kurrachee, under instructions from the Government to advise as to the conduct of some works for the improvement of the harbour which had been designed some years previously by the late Mr. James Walker with his assistance. These works were under the charge of Colonel Tremenheere as Chief Engineer of the province; but he had from the first expressed himself as strongly opposed to their principle. Several conferences took place between them solely on engineering questions, without, however, any agreement being arrived at. At these conferences the coast current was never mentioned, and Mr. Parkes had no suspicion that any theory concerning it was held by Colonel Tremenheere. Mr. Parkes made his report in March, 1864, and Colonel Tremenheere made his in the May following. It was in this report that the coast-current theory was first promulgated, and it was done in this way. Colonel Tremenheere asserted that Mr. Walker had been misinformed on many important points with regard to the physical characteristics of the harbour, but the only point cited in support of this assertion was the existence of this coast current. Even then, however, he abstained from saying more than that it was an important element. He did not say how it affected the question, and to this day he has never directly stated what effect it has on the general economy of the harbour. That it must be destructive of the harbour is a

conclusion which others have drawn—and, as Mr. Parkes submitted, inevitably drawn—from Colonel Tremenheere's premisses. Now, Colonel Tremenheere admitted that the existence of this current could not be made evident by direct observation; it could only be deduced from well-known physical conditions. The conclusion was therefore, so far at least as it affected the harbour, hypothetical, and Mr. Parkes met the hypothesis by a fact. The harbour is not filling up. A comparison of official charts made in 1838, 1849, and 1854, with the surveys made under his own directions in 1858, showed a maintenance of the same capacity throughout those twenty years. Local changes there might be, but no general deterioration. Again, old seafaring persons who had known the harbour for fifty years, never remembered it better than in 1858. It was, therefore, clear that there was no deterioration; and if deterioration be a necessary consequence of the hypothetical coast current, the hypothesis must give way. Colonel Tremenheere would appear himself to have felt this inconsistency, for in his paper just read he had stated that the sediment brought by the coast current was carried back again by an offing current in the opposite direction. It was curious that this current was not mentioned in his first report; in his second report it was alluded to as well known to exist, but as having only a very slight bearing on the question; but now, in his paper just read, it was made the very salvation of the harbour. So far as it affected the harbour question, then, the coast-current theory was cancelled by the offing-current theory. But Mr. Parkes could not accept either theory, though the practical import of the first might be destroyed by Colonel Tremenheere's late confession with respect to the second, and though the existence of this second current, at least in the immediate neighbourhood of the harbour, was indisputable. With regard to the theory itself, Colonel Tremenheere thus explained it: that the action of the sea-stroke on a line of shore forming an oblique angle with the crests of the waves was to produce a coast current, and he cited De la Beche in proof of this position; but De la Beche says it is the wind and not the sea-stroke which produces the current, and the wind is shown by actual observation never to blow obliquely on the shore in question, but at right angles, and consequently no coast current would be produced. The sea-stroke would have a different action; it would drive sand before it, but would produce no current in the body of the water. And even with respect to the sea-stroke, late observations showed that it was not always, even if it were ever, oblique, for during the last Monsoon it was distinctly observed by competent witnesses to have a direction which would fall dead on to the shore. The very foundation of Colonel Tremenheere's theory was therefore false. Colonel Tremenheere had, however, adduced two facts in support of his theory which were worthy of notice. The first was the existence of mica in the mud-banks of the harbour, which mineral was only found in the valley of the Indus. But was it not natural that the sea water for many miles from the mouth of the Indus should have diffused through it minute particles of this substance, some of which it would necessarily deposit in all sheltered inlets? This proved nothing. The second fact was the result of an interesting but very incomplete experiment made by Colonel Tremenheere during the Monsoon of 1865. He set afloat 864 bottles from the mouth of the Indus, and 214 of these, or about one-fourth, were found on the shore a few miles south-east of Kurrachee, none in or near the harbour, but all congregated in a remarkable manner at a distance of from 4 to 7 miles from it. This fact at first sight seemed to fit in well with the preconceived theory, up to a certain point, but a further examination showed it to be quite incompatible with that theory. These bottles were set afloat in the strong outset of the Indus during flood, when it runs 5 or 6 miles an hour. Was it to be supposed that immediately on emerging from the river-mouth they turned sharp round to the northward and followed the coast? Was it not far more natural to suppose that

they were carried far out to sea, and then drifted by wind and eddy currents back on to the shore? This latter supposition was much strengthened by the fact, that, of 216 bottles which were set afloat when the tide was rising and the outset consequently weak, only two stray ones were picked up, while of 144 which were set afloat in the hour and half after high water, when the outset was strongest and the course out to sea most free, no less than 75, or more than half, were picked up. Thus, then, though the gross result might at first sight seem to favour the coast-current theory, the first step in the examination of the details scattered it to the winds. Mr. Parkes was quite sure the onward progress of the port of Kurrachee would not be checked by Colonel Tremenheere's coast current.

In answer to the Chairman, Mr. Parkes stated that the amount expended upon that portion of the works which had been brought to bear upon the entrance was 57,000*l.*, and not a million, as had been stated elsewhere. A further sum of 200,000*l.* had been expended upon internal works which would ultimately affect the entrance, but they did not do so at present. The 57,000*l.* had been expended in the construction of a bank of stone 2 miles long upon the Keamarree sand-spit. The object was to cut through the bar in a direct line with the main harbour channel; and though this was not yet accomplished, yet the bar had been reduced in width from 400 to 200 feet, and its crest lowered 3 feet. In the mean time the circuitous channel round the end of the bar had been widened from 600 to 1200 feet, so as to allow of a more direct course into the harbour. The works were as yet incomplete, and their anticipated effects still more so, but the entrance had never been in so favourable a condition as it was at present, though some temporary inconvenience from the changes in the channels had been felt two or three years ago.

Mr. J. BRUNTON (Chief Engineer of the Scinde Railway) said he had just returned from Kurrachee, where he had been a resident for nine years. He had watched very particularly not only the conformation of the harbour, but the works which had been going on under Mr. Parkes. Colonel Tremenheere spoke of Manora Point as the western boundary of the Delta of the Indus. He thought the gallant officer was wrong, and that the Delta of the Indus must be considered to terminate at Ghuzree Point. That would place Kurrachee Harbour quite beyond the action of any current produced by the river Indus that might pass up the coast. He had had constant communication with Captain Giles, and with many officers of the port of Kurrachee, and they were all, without exception, of opinion that the current ran down the coast, and not up it; for all vessels, immediately they cross the bar of Kurrachee, are seen to be carried by the current at the mouth of the harbour down the coast, rather than up. With regard to the harbour works, two million tons of silt had been carried out of the harbour and thrown into the sea, at a cost of 6*l.* per ton. The whole harbour had thus been deepened and enlarged. When he first went there, twenty large full-rigged ships would have found it difficult to swing at their anchors in Kurrachee Harbour. When he left a few weeks ago, there were thirty-one large square-rigged vessels in the harbour, able to swing without any inconvenience. That was a proof that the groyne which had been formed had improved the harbour.

Captain CONSTABLE (late Indian Navy) said he could corroborate the remarks of the previous speakers. He had the honour to serve twenty years in the Indian Navy, which all geographers would recollect had rendered itself rather famous for its surveys. He was in the surveying-ships fourteen or fifteen years, and a great deal of his surveying operations were on the west coast of India and at Kurrachee. In 1839 the place was looked upon as a creek almost unfit to take ships into; but since then it had gone on improving. There was evidently no silt carried into it. In 1854 he (Captain Constable) was engaged as assistant upon the chart of Captain Grieve. He drew that chart, and he

had the means of comparing it with the Government Survey made in 1838 ; and he found an improvement of nearly 2 feet more water on the bar and in the channel. Again in the present year, a book, entitled 'The West Coast of Hindostan Pilot,' had been published by the Admiralty, written by Captain Taylor, of the late Indian Navy, one of our most able surveyors : in this work he told us that it was reported there was a depth of 26 feet at high water on Kurrachee Bar. Now, there never was such a depth all the time he knew Kurrachee. All these facts showed that the harbour was improving, and that there could not be any silting-up in operation. With regard to the current, no north-west current had been experienced in the Monsoon ; and Captain Grieve, in his 'Sailing Directions for the Coast,' published by the Bombay Government, said he was not aware of the existence of any currents beyond occasional sets to the south-east. He spoke of the offing, where ships navigate. He could also corroborate the fact of the south-west wind. Although called the South-west Monsoon, it was not south-west exactly ; certainly not on the coast of Scinde, for there its general direction is w.s.w. In reply to the Chairman, Captain Constable said that he knew of no harbour on the west coast of India equal to Kurrachee, except Bombay.

Major-General Sir W. GORDON, R.E., said he rose in consequence of the absence of Colonel Tremenheere, to state that the paper which had been read was drawn up by him in his official capacity as officer in charge of public works in that district. Not being satisfied with the works for the improvement of Kurrachee Harbour, he instituted investigations as to the physical geography of the lower part of the river. In his paper he had, with good taste, avoided disputed points of engineering ; and it would have been in good taste if those gentlemen who had made an attack upon him had followed his example.

Captain MAURY said he was not prepared to discuss the question of Kurrachee, but he desired to do homage to a philosophical mind and thank Colonel Tremenheere for the very capital paper that had been read. He thought the mouths of the Indus confirmed in their mute way the fact that there is a current there. From the information communicated that evening, it did not appear that the current, because it swept silt in the direction of Kurrachee Harbour, deposits it there, for the harbour appeared to be improving. There was no doubt there is a current, which carries the silt away as fast as the river brings it down. There was nothing more instructive upon this point than to compare the deltas of various rivers. Take, for instance, the delta of the Mississippi. The Mississippi pours down tremendous quantities of silt into still water ; there is no current in the Gulf at that place, and the consequence is that the river carries out its bed into the Gulf of Mexico, and then makes a channel for itself on the top of the bed. If there had been a current there, that silt would have been swept away, as it is from the Indus, as fast as it was brought down. Again, if we turned to the Amazon, the Rio de la Plata, and other great rivers, we find there are currents that not only sweep away the silt as fast as it is brought down, but they cut away the mainland, and with their eddies scoop out and make large recesses into the land from the mouths of the rivers. The difference between the Mississippi and the Indus is this :—the Mississippi discharges its silt into still water ; the Indus discharges its silt into running water. Whether the current from the Indus sweeps with more force to the south-east or north-west, the probability, according to the statements made by the gentlemen present, seems to be in favour of the south-east.

The CHAIRMAN expressed his regret that Colonel Tremenheere was not present to defend his own theory, but he had had two able defenders. It was not the business of the Society to decide questions in dispute, like the present one ; they had only to thank the writer of the paper, and also the gentlemen who had taken part in the discussion, for the valuable information they had afforded.
